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Studies on Permo-Trias of Madagascar. 6. First record of Cycloidea from the Lower Triassic (Olenekian) of Ambilobé region (NW Madagascar)

Abstract - We describe a small sample of cycloids, discovered in some outcrops from the Lower Triassic (Olenekian), located in Ambilobé region (NW Madagascar). Two new species are here described, *Cyclus madagascariensis* n. sp. and *Halicyne gondwanae* n. sp. (order Cycloidea Glaessner, 1928, family Cyclidae Packard, 1885). It is the first report of this type of crustaceans in the Gondwana. In fact, all previous specimens were collected in outcrops located in Laurasia (N America and Europe).

Key words: Crustacea, Cycloidea, Lower Triassic, NW Madagascar.

Riassunto - Studi sul Permotrias del Madagascar. 6. Prima segnalazione di cicliidi nel Triassico inferiore (Olenekiano) della regione di Ambilobé (NO Madagascar).

Viene descritto un piccolo campione di crostacei cicloidei, rinvenuti in alcuni affioramenti del Triassico inferiore (Olenekiano), localizzati nella regione di Ambilobé (NO Madagascar). Lo studio di questo campione ha portato alla descrizione di *Cyclus madagascariensis* n. sp. e di *Halicyne gondwanae* n. sp. (Ordine Cycloidea Glaessner, 1928, famiglia Cyclidae Packard, 1885). Il rinvenimento di crostacei cicloidei in Madagascar rappresenta una importante scoperta in quanto trattasi della prima segnalazione di questo gruppo di crostacei nel Gondwana; finora gli unici rinvenimenti erano limitati a giacimenti localizzati nel Laurasia (Nord America e Europa).

Parole chiave: Crustacea, Cycloidea, Triassico inferiore, NO Madagascar.

Introduction

The fossiliferous levels of the Lower Triassic marine sediments located S-SW of the village of Ambilobé (Fig. 1), about 150 km SW of Diego Suarez (Antsiranana) are known since the beginning of last century (Besairie, 1932).

This paper deals with the description of cycloid crustaceans from the Lower Triassic of the Ambilobé region (NW Madagascar), increasing not only our

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Fig. 1 – Geographical map of NW Madagascar. The arrow indicates Mahatsara outcrop where the study specimens were discovered.

Fig. 1 – Mappa geografica del NO Madagascar. La freccia indica il giacimento di Mahatsara dove gli esemplari studiati sono stati rinvenuti.

knowledge about this group of crustaceans, but representing the first record of cycloids in Gondwana.

The famous faunal assemblage of Ambilobé region, comprising invertebrates (ammonites, nautiloids, bivalves, annelids, limulids, crustaceans, like as decapods, thylacocephalans and conchostracans, and vertebrates (many fishes and rare amphibians), was the subject of many studies during the last century and at the beginning of this new century (for the references see Garassino and Pasini, 2002).

The present research is part of a program of studies started in the eighties of the last century by the Department of the Invertebrate Palaeontology of Museo Civico di Storia Naturale di Milano on the sample of its own collection of the Lower Triassic fossils of the Ambilobé region. This research program was carried out by the co-operation and the help of the late Dr. Jeannot Rasoanaivo, Director of Geological Service of Madagascar.

Previous studies of cycloids

Cycloid crustaceans are very rare in the fossil record and their morphological features are not well known because of their poor state of preservation.

Cycloid crustaceans were described for the first time by Phillips (1835) who, studying one specimen discovered in the Carboniferous of Yorkshire, ascribed it to *Aguostus radialis*, a trilobite. De Koninck (1841) concluded that Phillips' specimen was not a trilobite and described the genus *Cyclus*, for this specimen and for other samples from the Carboniferous of Belgium. Von Meyer (1838) reported a new species from the Muschelkalk, ascribing it to *Limulus agnotus*. Subsequently, von Meyer (1844) realised that the specimen previously ascribed to Xifosura, was not a limulid and so erected the new genus *Halicyne*, without pointing out its systematic position. Von Meyer (1847) described another specimen from the same beds, ascribing it to the same genus *Halicyne* von Meyer, 1844, but ascribing it to another species. So in the first part of the nineteenth century two genera of cycloid crustaceans were recognised: *Cyclus* de Koninck, 1841, and *Halicyne* von Meyer, 1844. Von Seebach (1857) collected three poorly preserved specimens from the Triassic of Thuringia, ascribing them to *Halicyne* von Meyer, 1844. Schafhäütl (1863) ascribed a form from the Triassic of Alps to *Carcinaspis pustulosus*, even though the morphological features of this specimens resembled *Halicyne* von Meyer, 1844. Woodward (1868, 1870, 1893, 1894) described cycloids in great numbers, ascribing five species from the Carboniferous of the British Isles to *Cyclus* de Koninck, 1841, while Peach (1883) ascribed another species to *Cyclus* de Koninck, 1841 from the Coal Measures of Scotland and Reed (1893) described a new species of *Cyclus* de Koninck, 1841 from the Carboniferous Limestone of the neighbourhood of Settle (Great Britain). In parallel with these studies, von Schauroth (1854) reported a small granulate shell, *Heuütrochiscus paradoxus*, from the Upper Permian of Germany, while Gemmellaro (1890) described from the Permian of Sicily (Italy) *Oouocarcinus insignis*, and Stolley (1915) reported the two species, *Cyclocarcinus serratus* and *Mesoprosopou traisiuuu* from the Triassic of the Alps and the Balkans. Packard (1885, 1886) described the first American species of *Cyclus* de Koninck, 1841 from the Pennsylvanian (Upper Carboniferous) deposits of Mazon Creek (Illinois). Rogers (1902) described some new forms from the Pennsylvanian limestone of Missouri, ascribing them to *Cyclus* de Koninck, 1841. Woodward (1905) pointed out some new morphologi-

cal features of two species previously described in 1868 and 1870. Reed (1908) described a new species of *Cyclus* de Koninck, 1841 from the Carboniferous Limestone of Ireland. Bill (1914) reported specimens of *Halicynae* von Meyer, 1844 from the Buntsandstein (France), while Trauth (1918) described *Halicynae* von Meyer, 1844 from the Upper Triassic of Alps. Trümpy (1957) erected a new species of *Halicynae* from the Muschelkalk of Wutachtal (Baden, Germany), Kramarenko (1961) extended the geographic range of *Cyclus* de Koninck, 1841 when he described a new species from the Lower Permian of Urals, and Goldring (1967) introduced a new species of *Cyclus* de Koninck, 1841 from the Upper Viséan (Lower Carboniferous) of England. Gall and Grauvogel (1967) added significantly to the knowledge of *Halicynae* von Meyer, 1844 and the Cycloidea Glaessner, 1928, but leaving some doubts on the morphology and affinities of *Halicynae* von Meyer, 1844. Glaessner (1969) provided a summary review of the cycloids, even though their status within the Crustacea remained uncertain. Zorn (1971) reported the presence of three species of *Halicynae* von Meyer, 1844 and an undescribed specimen of cycloid from the Ladinian (Middle Triassic) of Alps. Clark (1989) conducted the most recent study of *Cyclus* de Koninck, 1841 based on sample from the Namurian (Lower Carboniferous) shales of Scotland. Recently, Schram *et al.* (1997) ascribed the Cycloidea Glaessner, 1928 to Maxillopoda Dahl, 1956, recognising three families: Cyclidae Packard, 1885 with *Cyclus* de Koninck, 1841, *Halicynae* von Meyer, 1844, *Apionicon* Schram *et al.*, 1997 and *Carcinaspides* Glaessner, 1969 (*nom. subst. pro Carcinaspis* Schafhüttl, 1863); Hemithrochiscidae Trauth, 1918 with *Cyclocarcinides* Glaessner, 1969 (*nom. subst. pro Cyclocarcinus* Stolley, 1914), *Oonocarcinus* Gemmellaro, 1880 and *Hemithrochiscus* Schauroth, 1854; Mesoprosopidae Glaessner, 1928 with *Mesoprosopon* Stolley, 1914.

Material

The present study is based on five specimens, discovered in different outcrops around Ambilobé, along Ifasy river and in particular near Mahatsara village. The specimens are preserved more or less flattened inside subellipsoidal nodules. Their study allowed the description of *Cyclus madagascariensis* n. sp. (two specimens) and *Halicynae gondwanae* n. sp. (three specimens). The cycloids are associated with decapod crustaceans (MSNM i25461, i22868) and fishes, like as *Austrolosomus* (MSNM i25460).

Acronym: MSNM: Museo Civico di Storia Naturale di Milano.

Systematic Palaeontology

Class Maxillopoda Dahl, 1956
 Subclass Halicyna Gall and Grauvogel, 1967
 Order Cycloidea Glaessner, 1928
 Family Cyclidae Packard, 1885

Genus *Cyclus* de Koninck, 1841

Type species: Agnostus radialis Phillips, 1835



Fig. 2 – The new erosion, located at south of Mahatsara village, where the holotype of *Cyclus madagascariensis* n. sp. was discovered.

Fig. 2 – La nuova erosione, localizzata a sud del villaggio di Mahatsara, dove l'olotipo di *Cyclus madagascariensis* n. sp. è stato rinvenuto.

Cyclus madagascariensis n. sp.

Fig. 2

Diagnosis: carapace subcircular; dorsal surface of carapace slightly papillose; thin longitudinal ridge in median and posterior half of dorsal surface of carapace; antennules and antennae attached laterally to frontal extension; postero-lateral margins of carapace smooth.

Etyymology: the trivial name refers to Madagascar, where the specimens were discovered.

Holotype: MSNM i25462.

Paratype: MSNM i25460.

Type locality: area south of Mahatsara (Ifasy river); the holotype comes from a new erosion, located at south of Mahatsara village, from the holotype was collected recently in the outcrop by one of the authors (G. Pasini).

Geological age: Olenekian (Lower Triassic).

Occurrence and measurements: we ascribe to this species two specimens (MSNM i25460, i25462).

MSNM i25460: carapace length = 0.8 cm

MSNM i25462: carapace length = 0.8 cm; carapace width = 1 cm

Description: the body is subcircular in outline. The carapace has the form of a circular shield except for the anterior frontal extension, covering part of the head with antennules and antennae. The dorsal surface of carapace shows in the central part a thin longitudinal ridge on its median and posterior half, as well as a series of papillae located laterally and posteriorly. Even though the large antennules are incomplete, they extend laterally from the frontal extension of the head. The basal segment of the peduncle is subquadrangular in outline. The small antennae incomplete appear just dorsal and posterior to the antennules. The maxillule and the maxilla are not preserved, as well as the thoracopods.

Discussion. The carapace outline allows to ascribe these specimens to the order Cycloidea Glaessner, 1928 and the morphological features are typical of the family Cyclidae Packard, 1885, excluding their ascription to the family Mesoprosopidae Glaessner, 1928 owing to the pyriform carapace with postero-lateral spines, and to the family Hemithrochiscidae Trauth, 1918 provided of carapace with large tubercles located along the lateral margins, and rostral plate. Four genera belong to the family Cyclidae Packard, 1885: *Cyclus* de Koninck, 1841, *Halicyne* von Meyer, 1844, *Apionicon* Schram, Vonk and Hof, 1977, and *Carcinaspides* Glaessner, 1969. The subcircular outline of the carapace and the lack of rostral plate exclude the ascription of our specimens to *Apionicon* Schram, Vonk and Hof, 1977, the unlobate margin exclude their ascription to *Carcinaspides* Glassner, 1969, and the lack of underside of carapace with subparallel lamellae and the dorsal surface of carapace slightly papillose exclude their ascription to *Halicyne* von Meyer, 1844. We ascribe them to *Cyclus* de Koninck, 1841 for the subcircular outline of carapace, the dorsal surface slightly papillose, and the thin longitudinal ridge in median and posterior half of carapace.

Genus *Halicyne* von Meyer, 1844

Type species: Limulus agnotus von Meyer, 1838

Halicyne gondwanae n. sp.

Figs. 3, 4

Diagnosis: carapace subcircular; dorsal surface of carapace strongly papillose and with a central triangular papillose plate; underside of carapace in the thoracic region marked by transverse lamellae.

Etymology: the trivial name refers to Gondwana, continental mass to which Madagascar belongs.

Holotype: MSNM i13280.

Paratypes: MSNM i22868, i25461.

Type locality: Mahatsara (Ifasy river); the study specimens come from the type locality studied by the Department of the Invertebrate Palaeontology of Museo di Storia Naturale di Milano during the eighties of the last century and collected directly in the outcrop.

Geological age: Olenekian (Lower Triassic).

Occurrence and measurements: we ascribe to this species three specimens (MSNM i13280, i22868, i25461).

MSNM i13280: carapace length = 1.5 cm; carapace width = 1.2 cm

MSNM i22868: carapace length = 1 cm; carapace width = 1 cm

MSNM i25461: carapace length = 1.5 cm; carapace width = 1 cm



Fig. 3 – Distribution of the nodules on the ground in the new erosion, located south of Mahatsara village.

Fig. 3 – Distribuzione dei noduli sul terreno nella nuova erosione, localizzata a sud del villaggio di Mahatsara.

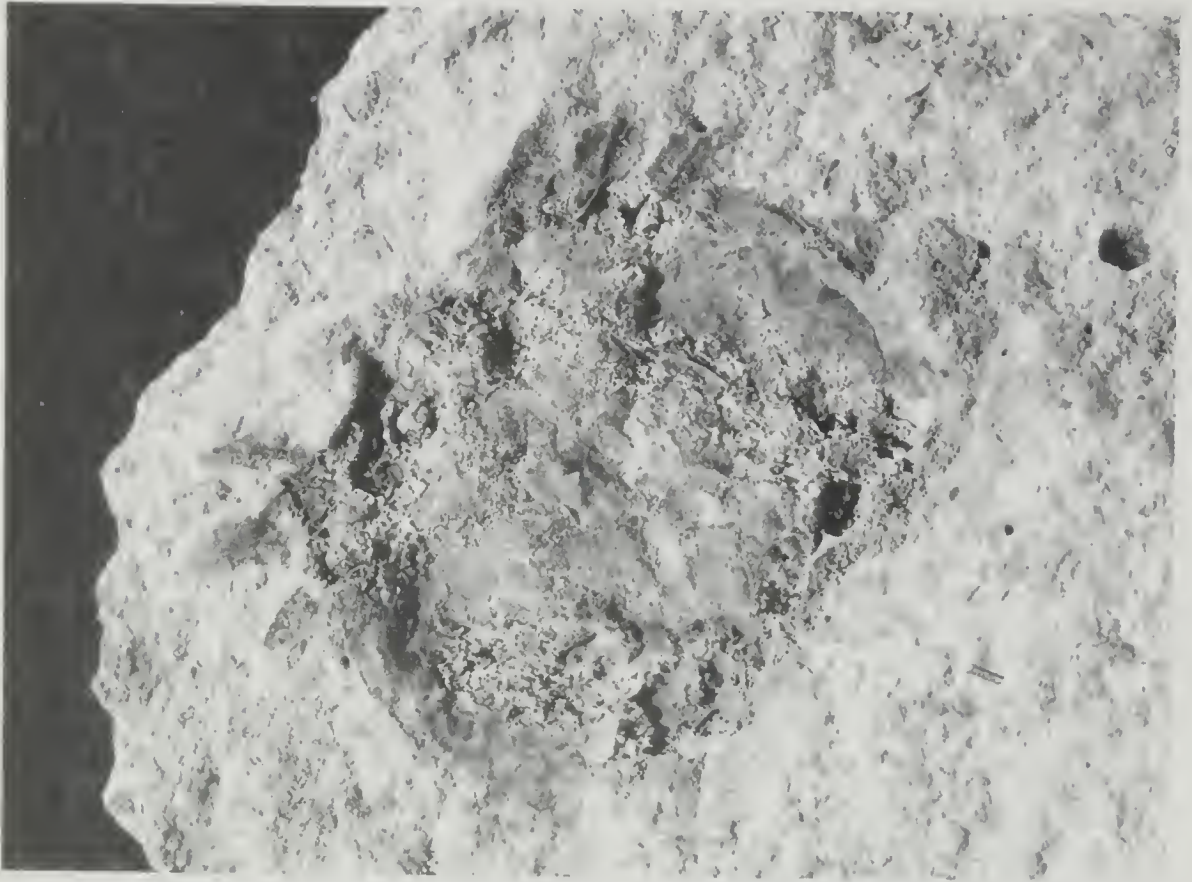


Fig. 4 – *Cyclus madagascariensis* n. sp., holotype, n. cat. MSNM i25462 (x7 ca.).
Fig. 4 – *Cyclus madagascariensis* n. sp., olotipo, n. cat. MSNM i25462 (x7 ca.).

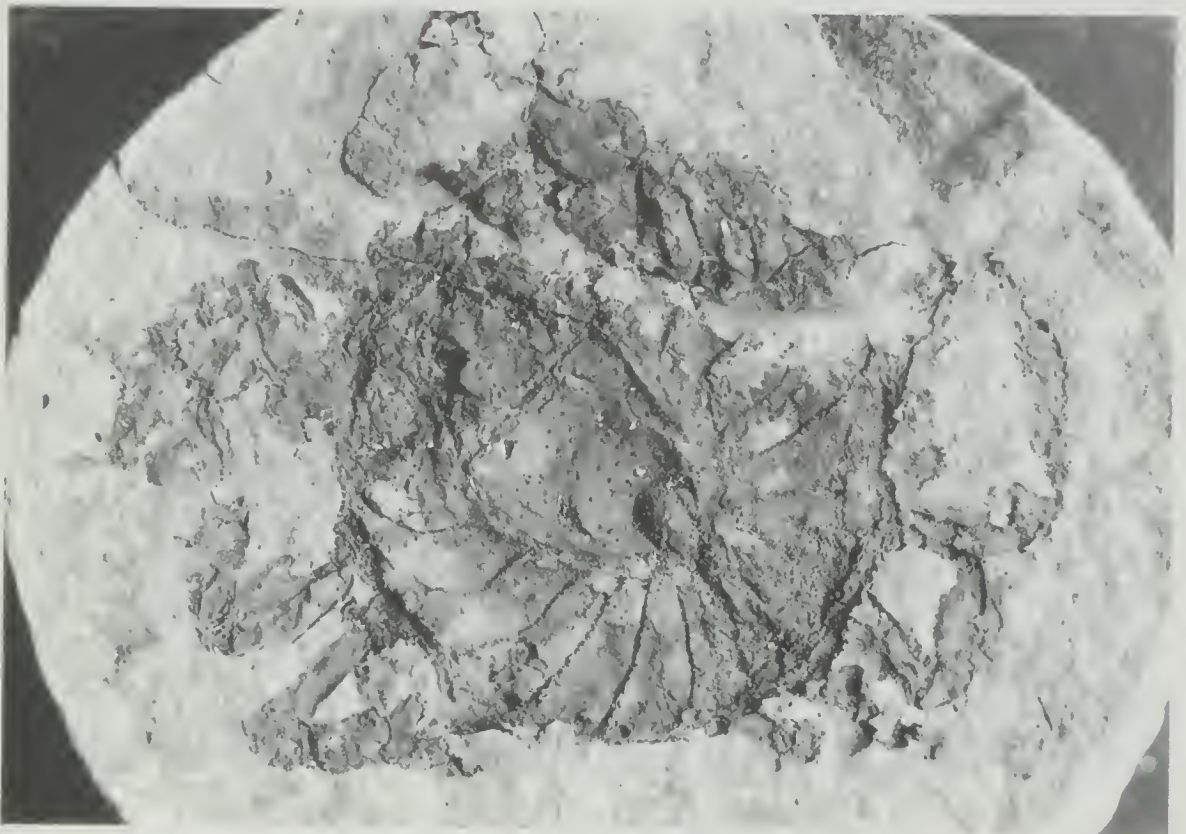


Fig. 5 – *Halicynne gondwanae* n. sp., holotype, n. cat. MSNM i13280 (x4 ca.).
Fig. 5 – *Halicynne gondwanae* n. sp., olotipo, n. cat. MSNM i13280 (x4 ca.).



Fig. 5 – *Halicyne gondwanae* n. sp., holotype, n. cat. MSNM i22868a (x4).
 Fig. 5 – *Halicyne gondwanae* n. sp., olotipo, n. cat. MSNM i22868a (x4).

Description: the body is subcircular in outline. The carapace has the form of a subcircular shield as long as wide. The dorsal surface of carapace shows a strong papillose surface, as well as a central triangular papillose plate. The underside of the carapace in the region of thorax has a dense arrangement of subparallel lamellae. None of the specimens preserve antennules and antennae, as well as maxillule and maxilla. The well-developed elongate five walking legs extend laterally from the body. Furthermore, at least the anterior-most of these have their distal extremities directed forward.

Discussion. The morphological features observed in these specimens allow, like the specimens ascribed to *Cyclus* de Koninck, 1841, to ascribe them to the family Cycloidea Glaessner, 1928, excluding their attribution to the other cycloid families. The subcircular outline of the carapace and the lack of rostral plate exclude their ascription to *Apionicon* Schram, Vonk and Hof, 1977, the unlobate margin exclude their ascription to *Carcinaspides* Glassner, 1969, and the lack of longitudinal ridge in median and posterior half of carapace, and the dorsal surface of carapace strongly papillose exclude their ascription to *Cyclus* de Koninck, 1841. We ascribe them to *Halicyne* von Meyer, 1844 for the subcircular outline of carapace, the dorsal surface strongly papillose, the underside of carapace with subparallel lamellae, and the elongate walking legs.

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